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A MODEL OF THE RELATIONSHIP BETWEEN LIGHT AND PRIMARY PRODUCTION IN AN ATOLL LAGOON

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The Tikehau atoll (Tuamotu Archipelago, French Polynesia) is located at 14°S 148°W. Phytoplankton and sand microalgae are the most important primary producers of the lagoon. They were studied for 4 years.

The relationship between light energy and lagoonal primary production was measured by using the ^{14}C method for phytoplankton and O_2 method for phytobenthos. Incubations, carried out *in situ*, were made at different depths and light exposition times.

Irradiance was high and 17% of the light energy measured at the surface reached 25 m (lagoon average depth). Maxima of phytoplankton and phytobenthos productions occurred at low depths; there was therefore no photoinhibition of photosynthesis. Correlations between light energy and primary production were strong, especially for phytobenthos. Multiplicative linear regression models (production *vs* light) associated with an exponential linear regression model (light *vs* depth), allowed planktonic and benthic primary production to be predicted from the depth and the light energy received at the surface. The benthic primary production exceeded the phytoplanktonic production in the upper 18 m. The total primary production (benthos + plankton) was constant with depth and depended only on light energy at the surface. One Einstein received at the lagoon surface allowed the growth production of 14 mg of carbon (water column + sediments).

INTRODUCTION

The major factor determining the productivity of primary producers is their photosynthetic capacity defined as the saturation level of the productivity *vs* irradiance (Larkum, 1983). Raven *et al.* (1979) have suggested that the photosynthetic capacity of algae varies according to their ecological characteristics. Maximum photosynthetic capacity is rarely achieved in natural communities owing to the limiting factors (stirring, light intensity, temperature, nutrient supply, inorganic carbon supply and oxygen concentration).

Light-photosynthesis models have been proposed in the marine environment to estimate phytoplankton production (*e.g.* Jassby & Platt, 1976; Platt & Jassby, 1976) and photosynthetic efficiency was quantified by the calculation of quantum yield coefficients. However no model has been proposed for microphytobenthic production and, consequently, for the whole productivity of microphyte (plankton + benthos).

The purpose of this paper is to build a light-photosynthesis model for total microphyte communities of an atoll lagoon.